

# EWTEC 2021 – ETIP and NEMMO Side Event

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Matthew Holland

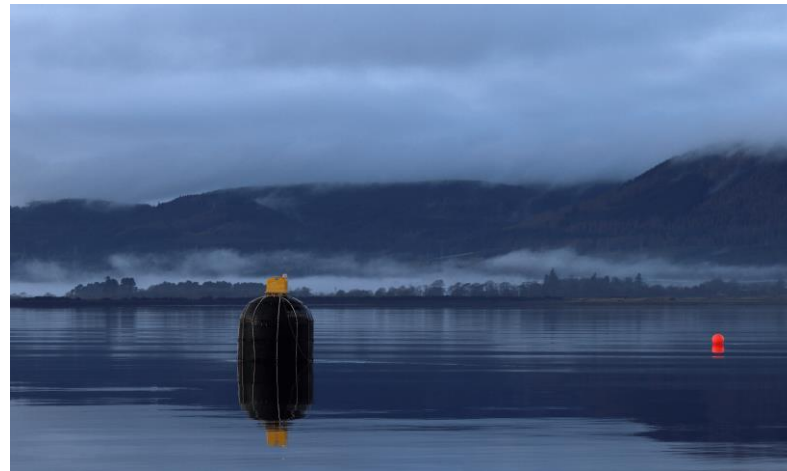
8<sup>th</sup> September 2021



# WES Programme

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- Comprehensive understanding and mitigation of challenges
- Engineering design application to a WEC prime mover
- Manufacturing and assembly requirements/constraints
- Recognise wave (and other) market opportunities for the material application
- Production of design decision tools to allow developers to material applicability
- Plan for dissemination of Stage 3 outputs and outcomes



# Online Design Tools

- Concrete – CONVEX, ARUP
  - Use of concrete on buoyant point absorber type-WECs
  - <https://convex.ade.arup.com/landing-page>
- Technical feasibility – concrete/steel data
- Cost – cost comparison with steel equivalent
- Carbon impact – emissions breakdown of production
- Construction – relevant techniques for WECs
- Operations – launch, towing and maintenance
- Scottish supply chain map – GIS map of ports and suppliers,

### Results and Further Analysis

Technical Feasibility Cost Carbon Impact Construction Operations Site Selection

#### Concrete and Steel Device Mass

Concrete structures are typically heavier than their steel equivalents. This tab compares the mass of steel and concrete versions of your device, and the resulting buoyancy ratios. This indicates whether concrete is suitable for your design from a technical feasibility point of view. Results are shown for normal concrete and Modified Normal Density Concrete (MNDC). Lightweight concrete is not considered due to additional design complexity associated with its use. MNDC enables a lighter solution without requiring design changes. For more information on material properties and typical strengths click [here](#).

Concrete device	MNDC device	Steel device	Assumptions
Mass 162 te	Mass 171 te	Mass 65 te	An external wall thickness of 300mm. This is the typical thickness required but may be reduced for sections that see lower loads.
Concrete mass 147 te	Concrete mass 154 te	Steel mass 50 te	An internal wall thickness of either 300mm or 200mm. If your buoyancy ratio could not be reached with a wall thickness of 300mm everywhere the internal wall thickness has been reduced, as these walls are likely to see lower loads.
Reinforcing steel mass 15 te	Reinforcing steel mass 17 te	Ballast mass 15 te	
Ballast mass 0 te	Ballast mass 0 te		
Buoyancy ratio 0.72	Buoyancy ratio 0.76	Buoyancy ratio 0.29	
<small>This buoyancy ratio is within the specified limits, when an inner wall thickness of 200mm is used.</small>	<small>This buoyancy ratio is within the specified limits, when all walls are 300mm thick.</small>		

### CAPEX Cost Breakdown

Select material: Concrete MNDC Steel

View cost per unit for: Prototype (1) Mass production (100)

Total Cost £215,460

Direct Costs	£93,678	Edit assumptions	Efficiency factor
Concrete supply and place	£9,135	Concrete rate (£/m <sup>3</sup> ) 108 Piling rate (h/m <sup>3</sup> ) 2 Labour cost (£/h) 20	100%
Reinforcement supply & fix	£13,974	Reinforcement rate (£/m <sup>3</sup> ) 600 Fixing rate (h/m <sup>3</sup> ) 15 Labour cost (£/h) 20	100%
Formwork	£18,000	Formwork rate (£/m <sup>2</sup> ) 75	100%
Structural steel	£50,000	Steel rate (£/m <sup>3</sup> ) 5000 Structural steel mass (t) 10	100%
Excess for PT	£2,569	Light to cost for PT (%) 25 % of structural area requiring PT	100%
Ballast	£0	Ballast rate (£/m <sup>3</sup> ) 50	100%

# Online Design Tools

- NetBuoy - TTI
  - Size of buoyant pod required for 5x geometry types
- <https://www.netbuoy.co.uk/design-tool>

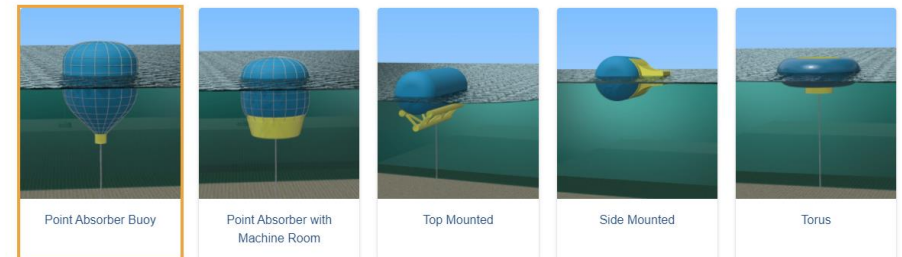
- Estimate of:

- Mass (buoy and net)
- Displacement
- Overall cost

The design tool instantly calculates the size and cost of a NetBuoy™ system when applied to your chosen WEC technology.

For a more detailed overview of the Design Tool, [click here](#)

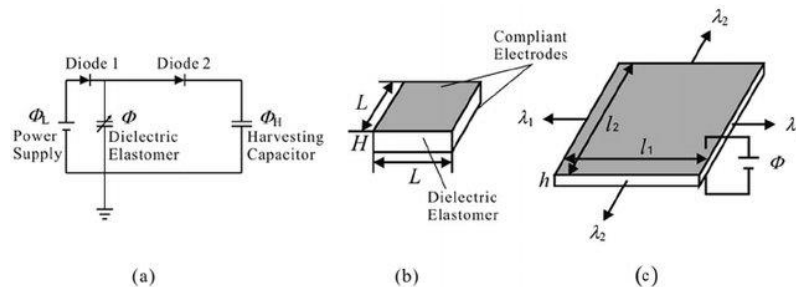
Select the image that best represents how you expect to integrate NetBuoy™ into your wave energy converter



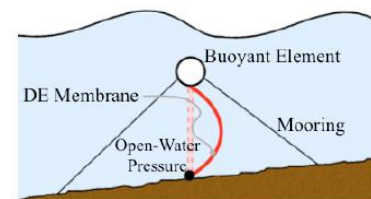
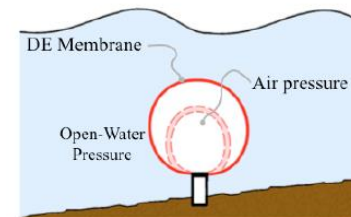
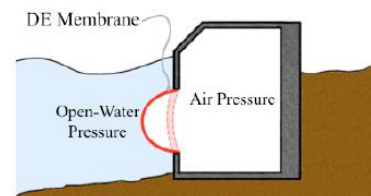
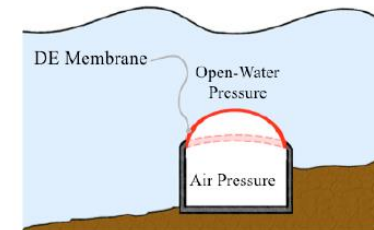
- Includes further information and detail about the development programme completed

# Flexible/Electroactive Materials

- 2018: WES Landscaping on Alternative Generation Technologies
- Electro-active polymers (EAPs)



- Challenges remain for design and implementation
  - Limited experience at practical design scales
  - What is achievable? What are limitations?
  - What are system requirements?
  - How to increase power density?
  - How to manufacture at scale?



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Twitter: @WaveEnergyScot  
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[waveenergyscotland.co.uk](http://waveenergyscotland.co.uk)

